Ten Ways to Improve Flash Storage System Performance

Camberley Bates, Evaluator Group
@camberleyB
Panel Moderator
Abstract

- Quite frequently, the wonderful flash storage systems, despite having NVMe, 3D flash, and other new technologies, doesn't run fast enough. The customer needs the performance for their current environment and the next breakthrough now, if not even sooner. This session will look at what are the issues facing systems performance and what approaches might blast through the bottlenecks. We will look at current and futures that address the demands in the Data Center, in the Cloud and in Research applications.
RANDY KERNS
EVALUATOR GROUP
SR STRATEGIST
Evaluator Group: Limiting Factors
Observed

- Customer Environments
  - Network Infrastructure
  - Application
  - Drivers
  - Synchronous Replication
DAN COBB

Dell EMC Fellow
No app is an island & all apps have a lifecycle

Take a systematic approach to app performance & utilization – and include your developers

**KEY ATTRIBUTES**

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<tbody>
<tr>
<td>Rigid ops</td>
<td>Complex ops</td>
<td>DevOps</td>
<td>DevOps</td>
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<tr>
<td>Infrastructure dependent</td>
<td>Infrastructure dependent</td>
<td>Infrastructure independent</td>
<td>Invisible infrastructure</td>
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<tr>
<td>1:1 App to infrastructure ratio</td>
<td>Several:one app to infrastructure ratio</td>
<td>Many:one app to infrastructure ratio</td>
<td>Virtually infinite:one app to infrastructure ratio</td>
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</tbody>
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**HIGH LEVEL STACK**

- Applications
- VM
- Infrastructure
- Hardware

- Applications
- VM
- Infrastructure
- Hardware

- Applications
- VM
- Platform
- BOSH
- VM
- Infrastructure
- Hardware

**FLASH FOUNDATION**

- DELL Technologies
The future is not what it used to be...

Solve for today’s need AND tomorrow’s opportunities

<table>
<thead>
<tr>
<th>BEFOERE...</th>
<th>...and NOW</th>
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<tbody>
<tr>
<td><strong>Users</strong></td>
<td>People</td>
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<tr>
<td><strong>User Experience</strong></td>
<td>Websites</td>
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<tr>
<td><strong>Application</strong></td>
<td>Java, .net</td>
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<td><strong>Data Management</strong></td>
<td>Relational databases</td>
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<td><strong>Orchestration</strong></td>
<td>Single cloud</td>
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<td><strong>OS/Virtualization</strong></td>
<td>VMs, Microsoft, Linux</td>
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<td><strong>Network</strong></td>
<td>Discrete: FC</td>
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<td><strong>Storage</strong></td>
<td>Block, File</td>
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<td><strong>Compute</strong></td>
<td>X86</td>
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<td><strong>Media</strong></td>
<td>SSD</td>
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</tbody>
</table>

+ Machines, AI, bots, real-time
+ AR/VR
+ Microservices, 12 factor, API-driven
+ In-memory dbs, memory-centric architectures
+ Cross cloud/mega-cloud
+ Uni-kernels, functions, containers, serverless
+ Open networking, integrated networking, NVMoF
+ Object, key value, memory-centric architectures
+ GPU, FPGA, TPU, IPU, diverse accelerators, ARM
+ Non-volatile memories, NVMe, SCM

Dell Technologies
Flash Storage Performance

Andrew Walls
IBM Fellow, CTO Flash Storage
On the surface everything looks great!

- Flash Read Latency is over an order of magnitude faster than Spinners.
- Write latency is similar, but an AFA can do thousands in parallel.
- NVMe semantics to simplify and speed up memory access

Challenges abound

- Complex storage functions like Data Reduction add metadata that must also be fetched
- Average Flash Latency increases as we go from SLC to MLC to TLC to QLC
- Software data path introduces queuing penalties and latency inconsistencies
Techniques for keeping performance High!

- Hardware Data Path as much as possible with Software management
  - Consistency and fastest possible
- Good Caching and Tiering to hold hot data and metadata
  - DRAM – Optane/LL NAND – Optane/Persistent Memory DIMM
- Efficient Garbage Collection – Do not fill up the array excessively
  - Overprovisioning can be key to consistent performance
  - Keep Write Amplification down
- Metadata copy or using Dedupe to accelerate Snapshots and replication
- NVMe in the server for reducing latency and CPU utilization in the host
SIAMAK NAZARI

HPE Fellow
Q&A